

## REMARKS

The Examiner is thanked for the thorough examination of the present application. The Office Action has again rejected all claims 1-26. Specifically, the Office Action has rejected claims 1-13 under 35 U.S.C. §101 as non-statutory subject matter, claims 8-11, 21, 23, 25, and 26 under 35 U.S.C. § 102(b) as allegedly anticipated by U.S. patent 6,118,452 to *Gannett*. The remaining claims have been rejected under 35 U.S.C. § 103(a) as unpatentable over *Gannett* in view of one or more cited references.

While Applicant respectfully maintains some of the previous arguments submitted on May 22, 2006, Applicant has made additional amendments and added additional comments in an attempt to help reinforce some of Applicant's previous arguments. In view of the foregoing amendments and following remarks, Applicant requests that all rejections be reconsidered and withdrawn.

### Rejections Under 35 U.S.C. § 101

The Office Action rejected claims 1-13 under 35 U.S.C. § 101. The Examiner alleges that the claimed invention is directed to non-statutory subject matter. The Examiner is correct in stating that the presently claimed embodiments are directed to a method of rendering graphic primitives. However, Applicant disagrees with the Examiner that these claims do not set forth an application of a method to product a tangible result. As known by those skilled in the art, the rendering of graphics data is processor-intensive. These claims, however, define "A multi-pass method of rendering a plurality of graphic primitives" and "A method of rendering a plurality of graphic

primitives." The claimed embodiments do produce a tangible result – improved methods for rendering.

The term "rendering" is well known in the computer graphics art, and will be recognized by persons skilled in the art as providing a tangible result. Indeed, one well-known information source is "Wikipedia" found on the Internet at [www.wikipedia.org](http://www.wikipedia.org). Wikipedia defines "rendering" as "***the process of generating an image*** from a model, by means of software programs. The model is a description of three dimensional objects in a strictly defined language or data structure. It would contain geometry, viewpoint, texture and lighting information. ***The image is a digital image or raster graphics image***. The term may be by analogy with an "artist's rendering" of a scene. 'Rendering' is also used to describe the process of calculating effects in a video editing file to produce final video output." The process of "generating an image" certainly provides a tangible, visible result. Accordingly, the methods defined in claims 1-13 provide tangible results.

Notwithstanding the foregoing, Applicant has amended independent claims 1, 8, and 13 to include a step of communicating data to a pixel shader. These amendments clearly bring the subject matter of these claims within the statutory scope of 35 U.S.C. § 101.

For at least these reasons, the 35 U.S.C. § 101 rejection of claims 1-13 should be withdrawn.

## Rejections Under 35 U.S.C. § 102(b)

### *Independent Claim 8*

The Office Action rejected claims 8-11, 21, 23, 25, and 26 under 35 U.S.C. § 102(b) as allegedly anticipated by *Gannett*. Turning to independent claim 8, this claim has been amended above and now recites:

8. A method of rendering a plurality of graphic primitives comprising:  
***passing***, within a graphic pipeline, only a limited set of graphic data for each primitive, wherein each primitive comprises a plurality of pixels;  
***processing the limited set of graphic data;***  
determining, for each primitive, whether the primitive has at least one visible pixel;  
communicating data associated with pixels of primitives determined to have at least one visible primitive to a pixel shader for rendering; and  
processing, within the graphic pipeline, a full set of graphic data for only those primitives determined to have at least one visible pixel.

*(Emphasis added.)*

For at least the following reasons, Applicant respectfully submits that claim 8 patently defines over the cited art for at least the reason that the cited art fails to disclose those features emphasized above.

The *Gannett* reference does not teach a method for rendering a plurality of graphics primitives by ***passing*** only a limited set of graphic data for each primitive on a first pass. Applicant again respectfully submits that this is a fundamental distinction between the cited *Gannett* reference and the claimed embodiments. Instead, *Gannett* teaches of sending a given span through a graphics pipeline where each span is comprised of a plurality of fragments. Each individual fragment then advances through the fragment operations processing stage. If texture or stippling has been enabled by the graphics application, the given fragment first enters a visibility pretest module,

where it is determined whether the fragment is visible. On the other hand, if texture or stippling is not enabled, the fragment bypasses the visibility pretest module altogether and proceeds to the next stage. Therefore, if either 1) the visibility pretest was not performed; or 2) the visibility test was performed and the fragment is determined to be visible, the fragment proceeds to normal per-fragment operations. On the other hand, if the fragment is determined to not be visible, no further processing takes place, and the span is traversed to begin processing the next fragment within the span. (Col. 14, line 45 to Col. 15, line 12) One **key distinction** between the *Gannett* reference and the claimed embodiments is that *Gannett* does not teach of passing limited graphics data for each fragment during per-fragment operations. As shown in FIGS. 4A and 4B, certain fragments may undergo normal or full operations (step 412, FIG. 4A). Therefore, a given fragment will undergo only partial processing (if the fragment is determined to not be visible) or full processing if the fragment is determined to be visible. In either instance, ALL graphics data associated with the fragment must be available in the event that it is determined to be visible and must undergo normal operations. Normal operations may include, for example, texture mapping operations, fog operations, antialiasing operations, pixel ownership test operations, scissor test operations and alpha test operations. (Col. 14, lines 14-18) Finally, Applicant draws Examiner's attention to the following text within the *Gannett* reference:

The graphics pipeline includes **a visibility pretest module, located at a first operational position** in the graphics pipeline, configured to determine whether a pixel will be visible or non-visible on the display screen. The pipeline also includes **one or more time-intensive modules operationally located at a second position in the graphics pipeline subsequent said first operational position**; and a process controller configured to prevent said one or more time-intensive modules from performing operations related to said non-visible pixels. **Advantageously, the present invention enables**

**the graphics system to selectively perform graphics pipeline operations which are related to pixels which are ultimately displayed on the display.** The processing associated with performing operations on non-displayed pixels is avoided thereby providing the graphics system with significant performance enhancements. (Abstract)

(*Emphasis added.*) Fragments which are determined to be visible undergo the more "time-intensive" operations located in a second position located down the graphics pipeline from the visibility pretest module located in a first position. Therefore by implication, ALL graphics data for each fragment must be passed into the graphics pipeline in case the fragment must undergo the time-intensive operations.

In the presently claimed embodiments, only a very limited set of graphics data (e.g., x, y, z, w coordinates) is passed into the pipeline for each pixel in a given primitive on the first pass. Other graphics data such as lighting and texture information is not passed. This significantly improves the bandwidth of the information being processed within the graphics pipeline on the first pass, resulting in significant bandwidth savings. This, in conjunction with the use of the compressed z-buffer and primitive mask, allows for very fast and efficient processing of each primitive on the second pass. On the first pass for each given primitive, only a reduced amount of graphics data is passed and processed for every pixel. On the second pass, only primitives determined to be visible undergo normal operations. Consequently, it's possible for a grouping of pixels (*i.e.*, a macro-pixel) to be trivially accepted or rejected after only passing a reduced amount of graphics data through the graphics pipeline on the first pass.

As independent claim 8 patently defines over *Gannett*, dependent claims 9-12 define over the cited art for least the same reasons.

### ***Independent Claim 21***

Turning next to claim 21, this claim has been amended above, and as amended claim 21 recites:

21. A graphics processor comprising:  
    logic configured ***to process only a limited set of graphic data passed into a graphic pipeline*** for each of a plurality of primitives, in a first pass within ***the*** graphic pipeline ***to determine*** whether the primitive has at least one visible pixel, wherein each primitive comprises a plurality of pixels;  
    logic configured to render, in a second pass within the graphic pipeline, only the primitives determined in the first pass to have at least one visible pixel.

(*Emphasis added.*) Applicant respectfully submits that claim 21 defines over the cited art for at least the reason that the cited art fails to disclose those features emphasized above.

The *Gannett* reference does not teach of a method for rendering a plurality of graphics primitives by ***passing*** only a limited set of graphic data for each primitive. As discussed in detail above for independent claim 8, each fragment referenced in *Gannett* contains ALL the data necessary to render that pixel to the screen. A fragment, by definition, is comprised of all data necessary needed to generate a pixel in a frame buffer. Because the pretest module taught by *Gannett* takes ALL necessary data to be rendered to the screen, it does not anticipate the first element of claim 21; namely, “logic configured to process only a limited set of graphic data ***passed*** into a graphic pipeline.”

As noted above for independent claim 8, certain fragments may undergo normal or full operations (step 412, FIG. 4A). Therefore, a given fragment may undergo only partial processing (if the fragment is determined to not be visible) or full processing

if the fragment is determined to be visible. In either instance, ALL graphics data associated with the fragment must be available in the event that it is determined to be visible and must undergo normal operations. For at least this additional reason, claim 21 patently defines over *Gannett*.

For this reason, claim 21 patently defines over the *Gannett* reference. As independent claim 21 patently defines over *Gannett*, dependent claims 22-26 define over the cited art for at least the same reasons.

### **Rejections Under 35 U.S.C. § 103(a)**

The Office Action rejected claims 1-3, 6, 7, and 13 under 35 U.S.C. § 103(a) as allegedly unpatentable over *Gannett* in view of U.S. patent 5,579,455 to *Greene*. Applicant respectfully requests reconsideration and withdrawal of this rejection for at least the following reasons.

#### ***Independent Claim 1***

Independent claim 1 recites:

1. A multi-pass method of rendering a plurality of graphic primitives comprising:
  - in a first pass:
    - passing only a limited set of graphic data for each primitive through a graphic pipeline;***
    - processing the limited set of data to build ***a compressed z-buffer, the compressed z-buffer comprising a plurality of z-records, each z-record embodying z information for a plurality of pixels;***
    - setting a visibility indicator, for each primitive, if any pixel of the primitive is determined to be visible;
  - in a second pass:
    - for each primitive, determining whether the associated visibility indicator for that primitive is set;
    - discarding, without passing through the graphic pipeline, the primitives for which the associated visibility indicator is not set;

passing a full set of graphic data for each primitive determined to have the associated visibility indicator set; and

performing a two-level z-test on graphic data, wherein a first level of the z-test compares the graphic data of a current primitive with corresponding information in the compressed z-buffer, and wherein a second level of the z-test is performed on a per-pixel basis in a z-test manner, wherein the second level z-test is performed only on pixels within a record of the compressed z-information in which the first level z-test determines that some but not all pixels of an associated macropixel are visible; and

communicating data associated with pixels of macropixels determined to be visible to a pixel shader for rendering.

(*Emphasis added.*) Applicant respectfully submits that claim 1 patently defines over the cited art for at least the reason that the cited art fails to disclose those features emphasized above. The Office Action alleges that *Gannett* discloses all claimed features, except that the z-buffer is a compressed z-buffer and that a two-level z-test is performed. In fact, *Gannett* fails to disclose a number of other significant claimed features. First, and as noted above, *Gannett* does not disclose a method for rendering a plurality of graphics primitives by **passing** only a limited set of graphic data for each primitive. This alone distinguishes over the application of *Gannett*.

As cited in the *Gannett* reference above for independent claim 8, fragments which are determined to be visible undergo the more "time-intensive" operations located in a second position located down the graphics pipeline from the visibility pretest module located in a first position. Therefore by implication, ALL the graphics data for each fragment must be passed into the graphics pipeline in order to potentially undergo time-intensive operations.

Even assuming, *arguendo*, that the allegations in the Office Action regarding the *Gannett* reference are true, neither the *Gannett* reference nor the *Greene* reference, separately or in combination, disclose a **z-buffer comprising a**

**plurality of z-records, each z-record embodying z information for a plurality of pixels.**

As acknowledged by the Office Action, “*Gannett* does not teach that the z-buffer is a compressed z-buffer and performing a two-level z-test.” (Office Action, page 14, 2<sup>nd</sup> paragraph) In addition, the *Greene* reference does not teach of a compressed z-buffer comprising a plurality of z-records, each containing z information for multiple pixels.

The Examiner cited the following text from the *Greene* reference (Col. 5, lines 51-61):

The basic idea of the **Z-pyramid** is to use a conventional depth buffer (Z-buffer) as the finest level in the pyramid and **then combine four Z values** (a 2.times.2 window) at each level **into one Z value** at the next coarser level by choosing the farthest Z from the observer. **Every entry in the pyramid therefore represents the farthest Z for a square area of the Z-buffer.** At the coarsest level of the pyramid there is a single Z value which is the farthest Z from the observer in the whole image.

*(Emphasis added.)*

The Examiner apparently equates the concept of the image-space Z-pyramid taught by the *Greene* reference to the compressed z-buffer disclosed in the present application.

The Applicant disagrees with the Examiner’s reasoning. As cited in the *Greene* reference above, “**Every entry in the pyramid therefore represents the farthest Z for a square area of the Z-buffer.**” That is, each entry within the z-pyramid is comprised of a z value. The pyramid is comprised of different levels which correspond to different levels of coarseness. Hence, the structure and function of the z-pyramid is different from the compressed z-buffer disclosed in the present application.

The compressed z-buffer disclosed in the present application provides condensed depth information for multiple pixels. The compressed z-buffer may be comprised of a variety of structures and embodiments. As an example, the compressed z-buffer may be comprised of a plurality of records. Each individual record within a compressed z-

buffer may then include a minimum z-value, a maximum z-value, and a 64-bit mask. The compressed z-buffer allows a grouping of pixels (*i.e.*, a macro-pixel) to be quickly and efficiently accepted or rejected during the second pass, depending on the visibility of the collective group of pixels. Essentially, if a group of pixels is visible or not visible, then that information is stored within a single record, rather than redundantly stored in separate records for each pixel. The *Greene* reference does not teach of such a compressed z-buffer. For at least these reasons, the rejection of claim 1 should be withdrawn.

As independent claim 1 patently defines over the cited art, dependent claims 2-7 define over the cited art for at least the same reasons.

### ***Independent Claim 13***

Turning next to independent claim 13, the Office Action rejected claim 13 under 35 U.S.C. §103(a) as allegedly obvious over the combination of *Gannett* and *Greene*.

Claim 13 has been amended above, and as amended claim 13 recites:

13. A method of rendering a plurality of graphic primitives comprising:  
    ***passing*** in a first pass, within a graphic pipeline, ***only a limited set of graphic data for each primitive***, wherein each primitive comprises a plurality of pixels;  
    processing the limited set of data to build a compressed z-buffer, the compressed z-buffer comprising a plurality of z-records, each z-record embodying z information for a plurality of pixels;  
    in a second pass, within the graphic pipeline, performing a two-level z-test on graphic data, wherein a first level of the z-test compares the graphic data of a current primitive with corresponding information in the compressed z-buffer, and wherein a second level of the z-test is performed on a per-pixel basis in a z-test manner, wherein the second level z-test is performed only on pixels within a record of the compressed z-information in which the first level z-test determines that some but not all pixels of a macropixel are visible; and

communicating data associated with pixels of macropixels determined to be visible to a pixel shader for rendering.

(*Emphasis added.*) Applicant respectfully submits that claim 13 patently defines over the cited art for at least the reason that the cited art fails to disclose those features emphasized above.

As noted above for independent claims 1 and 8, one key distinction between the *Gannett* reference and the presently claimed embodiments is that *Gannett* does not teach of passing limited graphics data for each fragment during per-fragment operations. As shown in FIGS. 4A and 4B, certain fragments may undergo normal or full operations (step 412, FIG. 4A). Therefore, a given fragment may undergo only partial processing (if the fragment is determined to not be visible) or full processing if the fragment is determined to be visible. In either instance, ALL graphics data associated with the fragment must be available in the event that it is determined to be visible and must undergo normal operations.

For at least this additional reason, claim 13 patently defines over *Gannett*. For at least this reason, the rejection of claim 13 should be withdrawn.

#### ***Independent Claim 14***

Turning next to independent claim 14, the Office Action rejected this claim under 35 U.S.C. § 103(a) as allegedly unpatentable over the combination of *Gannett* and U.S. patent 5,990,904 to *Griffin*. Applicant respectfully requests reconsideration and withdrawal of this rejection.

Claim 14 recites:

14. A graphics processor comprising:

first-pass logic configured to **deliver to a graphic pipeline, in a first pass, only a limited set of graphic data for each primitive**, wherein each primitive comprises a plurality of pixels;  
logic configured to process the limited set of graphic data for each primitive to create a compressed z-buffer;  
logic configured to determine, for each primitive, whether the primitive has at least one visible pixel;  
second-pass logic configured to deliver to the graphic pipeline, in a second pass, a full set of graphic data for only those primitives determined to have at least one visible pixel, the second-pass logic further configured to inhibit the delivery of graphic data to the graphic pipeline for primitives not determined to have at least one visible pixel.

(*Emphasis added.*)

Applicant respectfully submits that claim 14 patently defines over the cited art for at least the reason that the cited art fails to disclose those features emphasized above. The *Gannett* reference does not describe a graphics processor comprising “*first-pass logic configured to deliver to a graphic pipeline, in a first pass, only a limited set of graphic data for each primitive*” as disclosed in claim 14. As noted above for independent claims 1 and 8, one key distinction between the *Gannett* reference and the presently claimed embodiments is that *Gannett* does not teach of passing limited graphics data for each fragment during per-fragment operations. As shown in FIGS. 4A and 4B, certain fragments may undergo normal or full operations (step 412, FIG. 4A). Therefore, a given fragment may undergo only partial processing (if the fragment is determined to not be visible) or full processing if the fragment is determined to be visible. In either instance, ALL graphics data associated with the fragment must be available in the event that it is determined to be visible and must undergo normal operations. For at least this additional reason, claim 14 patently defines over the cited art.

As independent claim 14 patently defines over the cited art, dependent claims 15-20 define over the cited art for at least the same reasons.

For at least the reasons set forth above, even if Gannet and Greene can be properly combined, the combination still fails to disclose all features of the claimed embodiments, and the rejections should be withdrawn. As a separate and independent basis for the patentability of all claims, Applicant respectfully traverses the rejections as failing to identify a proper basis for combining the cited references. In combining these references, the Office Action stated only that the combination would have been obvious "because Greene suggests the advantage of rejecting hidden geometry very quickly and having an algorithm which is much faster than traditional ray-casting or z-buffering." (Office Action, page 15). This alleged motivation is clearly improper in view of well-established Federal Circuit precedent.

It is well-settled law that in order to properly support an obviousness rejection under 35 U.S.C. § 103, there must have been some teaching (either express or implied) in the prior art to suggest to one skilled in the art that the claimed invention would have been obvious. W. L. Gore & Associates, Inc. v. Garlock Thomas, Inc., 721 F.2d 1540, 1551 (Fed. Cir. 1983). More significantly,

"The consistent criteria for determination of obviousness is whether the prior art would have suggested to one of ordinary skill in the art that this [invention] should be carried out and would have a reasonable likelihood of success, viewed in light of the prior art. ..." Both the suggestion and the expectation of success must be founded in the prior art, not in the applicant's disclosure... In determining whether such a suggestion can fairly be gleaned from the prior art, the full field of the invention must be considered; for the person of ordinary skill in the art is charged with knowledge of the entire body of technological literature, including that which might lead away from the claimed invention."

(*Emphasis added.*) In re Dow Chemical Company, 837 F.2d 469, 473 (Fed. Cir. 1988).

In this regard, Applicant notes that there must not only be a suggestion to combine the functional or operational aspects of the combined references, but that the Federal Circuit also requires the prior art to suggest both the combination of elements and the structure resulting from the combination. Stiftung v. Renishaw PLC, 945 Fed.2d 1173 (Fed. Cir. 1991). Therefore, in order to sustain an obviousness rejection based upon a combination of any two or more prior art references, the prior art must properly suggest the desirability of combining the particular elements to derive a multi-pass graphics rendering apparatus, as claimed by the Applicant.

When an obviousness determination is based on multiple prior art references, there must be a showing of some “teaching, suggestion, or reason” to combine the references. Gambro Lundia AB v. Baxter Healthcare Corp., 110 F.3d 1573, 1579, 42 USPQ2d 1378, 1383 (Fed. Cir. 1997) (also noting that the “absence of such a suggestion to combine is dispositive in an obviousness determination”).

Evidence of a suggestion, teaching, or motivation to combine prior art references may flow, inter alia, from the references themselves, the knowledge of one of ordinary skill in the art, or from the nature of the problem to be solved. See In re Dembiczak, 175 F.3d 994, 1000, 50 USPQ2d 1614, 1617 (Fed. Cir. 1999). Although a reference need not expressly teach that the disclosure contained therein should be combined with another, the showing of combinability, in whatever form, must nevertheless be “clear and particular.” Dembiczak, 175 F.3d at 999, 50 USPQ2d at 1617.

If there was no motivation or suggestion to combine selective teachings from multiple prior art references, one of ordinary skill in the art would not have viewed the

present invention as obvious. See In re Dance, 160 F.3d 1339, 1343, 48 USPQ2d 1635, 1637 (Fed. Cir. 1998); Gambro Lundia AB, 110 F.3d at 1579, 42 USPQ2d at 1383 ("The absence of such a suggestion to combine is dispositive in an obviousness determination.").

Significantly, where there is no apparent disadvantage present in a particular prior art reference, then generally there can be no motivation to combine the teaching of another reference with the particular prior art reference. Winner Int'l Royalty Corp. v. Wang, No 98-1553 (Fed. Cir. January 27, 2000). The rationales relied on by the Office Action in the present application are merely generic statements, that have nothing to do specifically with the structures disclosed in the other references. As such, these rationales cannot be properly viewed as proper motivations for combining the specific teachings of the individual references. Indeed, the generic motivations advanced by the present Office Action could be used to support a combination of ANY references, which is clearly contra to the cited Federal Circuit precedent and the clear intent of 35 U.S.C. § 103.

For at least the additional reason that the Office Action failed to identify proper motivations or suggestions for combining the various references to properly support the rejections under 35 U.S.C. § 103, those rejections should be withdrawn.

## CONCLUSION

In view of the foregoing, it is believed that all pending claims are in proper condition for allowance. Should the Examiner have any questions regarding this response, the Examiner is invited to telephone the undersigned attorney at (770) 933-9500.

No fee is believed to be due in connection with this response to Office Action. If, however, any fee is believed to be due, you are hereby authorized to charge any such fee to deposit account No. 20-0778.

Respectfully submitted,



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